(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 November 2000 (30.11.2000)

PCT

(10) International Publication Number
WO 00/72632 A2

(51) International Patent Classification[7]: H04R 25/00

(21) International Application Number: PCT/US00/13438

(22) International Filing Date: 16 May 2000 (16.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/317,485 24 May 1999 (24.05.1999) US

(71) Applicant: SONIC INNOVATIONS, INC. [US/US]; 2795 East Cottonwood Parkway, Salt Lake City, UT 84121 (US).

(72) Inventor: BRIMHALL, Owen, D.; 11217 South Crescentridge Circle, South Jordan, UT 84095 (US).

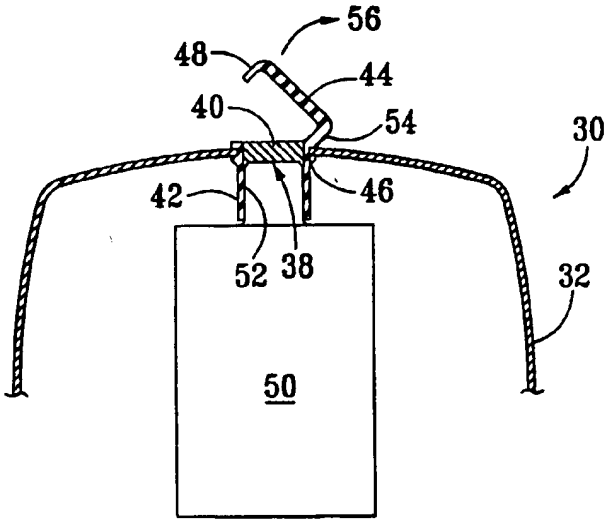
(74) Agent: LYON & LYON LLP; Neugeboren, Craig, A., Suite 4700, 633 West Fifth Street, Los Angeles, CA 90071-2066 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: COMBINED RECEIVER SUSPENSION AND CERUMEN GUARD DEVICE FOR AN IN-THE-CANAL HEARING AID



(57) Abstract: An In-The-Canal hearing device includes a flexible receiver suspension member seated in the sound port of the receiver housing of a hearing device. The suspension member includes a tubular portion extending into the receiver housing, wherein the tubular portion is configured to retain a receiver unit in a position such that sound waves emitted from the receiver unit are directed through the sound port. The suspension member further includes a cover piece configured to block cerumen from accessing the sound port when the cover is disposed in a closed position. The cover may be integrally molded with the suspension member as a single piece and is preferably fashioned with a positioning lip extending from an outer edge of the cover and configured to prevent the cover from sealing the sound port when the cover is in a closed position.

WO 00/72632 A2

Published:
— *Without international search report and to be republished upon receipt of that report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DESCRIPTION

Combined Receiver Suspension And Cerumen Guard Device For An In-The-Canal Hearing Aid

Field Of The Invention

The present invention pertains to hearing aids. More particularly, the present invention pertains to cerumen guards and receiver assemblies for use in hearing devices.

Background Of The Invention

The modern trend in the design and implementation of hearing devices is focusing to a large extent on reducing the physical size of the hearing device. Miniaturization of hearing device components is becoming increasingly feasible with rapid technological advances in the fields of power supplies, sound processing electronics and micro-mechanics. The demand for smaller and less conspicuous hearing devices continues to increase as a larger portion of our population ages and faces hearing loss. Those who face hearing loss also encounter the accompanying desire to avoid the stigma and self consciousness associated with this condition. As a result, smaller hearing devices which are cosmetically less visible are increasingly sought after.

Hearing device technology has progressed rapidly in recent years. First generation hearing devices were primarily of the Behind-The-Ear (BTE) type, where an externally mounted device was connected by an acoustic tube to a molded shell placed within the ear. With the advancement of component miniaturization, modern hearing devices rarely use this Behind-The-Ear technique, focusing primarily on one of several forms of an In-The-Canal (ITC) hearing device.

Three main types of ITC hearing devices are offered by audiologists and physicians. In-The-Ear (ITE) devices rest primarily in the concha of the ear and have the disadvantages of being fairly conspicuous to a bystander and relatively bulky to wear. Smaller ITC devices fit partially in the concha and partially in the ear canal and are less visible but still leave a substantial portion of the hearing device exposed. Recently, Completely-In-The-Canal (CIC) hearing devices have come into greater use. As the name implicates, these devices fit deep within the ear canal and are essentially hidden from view from the outside.

In addition to the obvious cosmetic advantages these types of in-the-canal devices provide, they also have several performance advantages that larger, externally mounted devices do not offer. Placing the hearing device deep within the ear canal and proximate

to the tympanic membrane (ear drum) improves the frequency response of the device, reduces distortion due to jaw extrusion, reduces the occurrence of the occlusion effect and improves overall sound fidelity.

The anatomy of the ear canal includes ceruminous glands, which secrete a yellowish, wax-like substance called cerumen (i.e., ear wax). Cerumen tends to accumulate in the ear canal. Due to the action of cilia located within the ear canal, as well as natural movements of the ear canal itself, cerumen gradually propagates outward. When a hearing device is inserted into the ear canal, it is susceptible to the effects of cerumen accumulation. Cerumen can often mix with sloughed off skin and dirt, further impairing operation of the hearing device.

With the onset of smaller and more sophisticated hearing devices, the buildup of cerumen can have more severe effects on their performance. Receivers (i.e., acoustic speakers) utilized in most modern hearing devices are particularly susceptible to performance problems and damage from cerumen accumulation. Initially, cerumen accumulation physically blocks the receiver port located on the distal end of the device, i.e., adjacent the tympanic membrane, occluding the acoustic path and preventing sound waves from efficiently reaching the tympanic membrane. Eventually, the cerumen can penetrate into the receiver housing and damage the sensitive mechanical and electrical components located within the housing. Most of these internal components are critical to the operation of the hearing device and their failure will necessitate repair or replacement of the hearing device. The monetary and time costs associated with replacing failed hearing devices due to cerumen clogging and receiver damage are significant.

U.S. Patent No. 5,401,920, entitled "Cerumen Filter For Hearing Aids" ("the '920 patent"), discloses a replaceable and disposable wax guard that is affixed over the sound port of an in-the-ear hearing aid by means of a pressure sensitive tape. The filter itself is porous to sounds but is receptive to cerumen. While providing some level of protection against cerumen damage to the internal components of the hearing device, this and other similar types of "filters" become quickly soiled, resulting in poor device performance due to a blocked receiver port. As such, the disposable filter must be frequently replaced by the user. The small size of these devices often requires a high level of visual acuity and dexterity for such maintenance.

U.S. Patent No. 5,327,500, entitled "Cerumen Barrier for Custom In The Ear Type Hearing Instruments" ("the '500 patent"), discloses a cerumen barrier for a custom, in the ear type hearing instrument. The cerumen barrier consists of a small door covering the receiver port which can be manually rotated open to provide cleaning under the door and around the receiver port. While also providing some level of protection against cerumen

to the internal components of the hearing device, the '500 patent also requires significant user intervention to clean the filter.

Knowles sells an "active wax protection system" under the trademark WaxBuster®, featuring a mechanical piston device that acts at the receiver port. When the receiver port is manually pressed, a ring moves down on the piston rod to push cerumen out of the sound channel. The ring returns to its original position by means of a coil spring. The device adds significant size to the hearing aid and must be manually operated. A further disadvantage of the WaxBuster® system is that the tip is directly open to wax when the aid is inserted into the ear canal. Scooping of wax into the receiver port on insertion is a significant cause of clogging.

Wax springs are small coils of wire inserted into the receiver tube at the end of the receiver port. They act as a wax trap and help keep wax from getting deep into the receiver. They are not easily cleaned and are generally too small for user replacement. Replacement generally requires training and special small tools. The wax spring also exposes the tip of aid to direct scooping of wax on aid insertion.

Various other devices, and particularly those described in U.S. Patent No. 4,879,750, entitled "Hearing Aid With Cerumen Trapping Gap," U.S. Patent No. 5,105,904, entitled "Cerumen Trap For Hearing Aid," and U.S. Patent No. 5,166,659, entitled "Hearing Aid With Cerumen Collection Cavity," utilize various types of trapping mechanisms to collect cerumen. However, in each of these devices the cerumen is simply collected and a user must still manually clear it from the device.

Summary Of The Invention

The present invention provides a flexible receiver suspension member seated in the sound port of the receiver housing of a hearing device. In a preferred embodiment, the suspension member includes a tubular portion extending into the receiver housing, wherein the tubular portion is configured to retain a receiver unit in a position such that sound waves emitted from the receiver unit are directed through the sound port. In accordance with a further aspect of the invention, the suspension member further includes a cerumen guard cover piece configured to substantially cover the sound port when the cover is disposed in a closed position.

In a preferred embodiment, the cerumen guard is integrally molded with the suspension member as a single piece, wherein the guard is "hingedly" attached to the suspension member so as to allow it to be alternately opened, i.e., away from the sound port, or closed, i.e., covering the sound port. The cerumen guard is fashioned with a positioning lip extending from an outer edge, wherein the positioning lip is configured to

prevent the cerumen guard from sealing the sound port when the cerumen guard is in a closed position.

Other and further aspects and advantages of the invention will become apparent hereinafter.

Brief Description Of The Drawings

The drawings illustrate both the design and utility of the preferred embodiments of the present invention, in which similar elements in different embodiments are referred to by the same reference numbers for purposes of ease in illustration of the invention, wherein:

Fig. 1 is a cut away section of an ear canal and its associated anatomy;

Fig. 2 is a perspective view of an in-the-canal hearing device seated within an ear canal, illustrating the partial blockage of a distally located sound port by cerumen;

Fig. 3 is a preferred in-the-canal hearing device having a combined receiver suspension and cerumen guard device seated in a sound port of its receiver housing;

Fig. 4 is a cut-away side view of the distal end of the receiver housing of Fig. 3, further illustrating the combined receiver suspension and cerumen guard device, with the cerumen guard shown in a closed position; and

Fig. 5 depicts cerumen guard of Fig. 3 in an open position, e.g., for cleaning.

Detailed Description Of The Drawings

Fig. 1 illustrates the general anatomy of an ear. Generally, the ear includes a canal 10 with fleshy walls 11, ceruminous glands 12, a tympanic membrane 16 (ear drum) and a concha 17. The ceruminous glands 12 secrete a yellowish wax-like substance called cerumen 14 (ear wax), which accumulates within the ear canal 10 and, most particularly, along the fleshly walls 11. Cerumen 14 naturally propagates outward from the inner portions of the ear canal 10 towards the concha 17. This outward movement is due in part to the action of tiny cilia (not shown) located along the fleshy walls 11 and in part to the natural movements of the ear canal 10. The tympanic membrane 16 is located at the deepest portion of the ear canal 10, and transmits acoustic energy into the inner ear where it is eventually interpreted by the brain as sounds.

Fig. 2 illustrates how the accumulation of cerumen can interfere with the operation of an in-the-canal (ITC) hearing device 18. While Fig. 2 illustrates a completely-in-the-canal (CIC) hearing device 18, this is by example only and similar problems exist with the use of most other types of hearing devices. The ITC hearing device 18 forms an acoustic seal between the tympanic membrane 16 and the external environment beyond the concha

17. Located on a distal end 20 of the hearing device 18 is a sound port 24 covered by a filter 22. When cerumen 14 becomes trapped by the hearing device 18, or is secreted beyond the distal end 20, it eventually clogs the filter 22, thereby blocking the sound port 24. Maintaining a clear acoustic path is essential to the proper operation of the hearing device 18. When the sound port 24 becomes even partially obstructed, the efficiency and performance of the hearing device 18 is affected. Cerumen can also migrate through the sound port 24, jamming the miniature mechanical and/or electrical components that make up the functional aspects of a receiver (not shown) located therein.

Referring to Fig. 3, a preferred ITC hearing device 30 includes a receiver housing 32 substantially enclosed in a conformal jacket 34. As disclosed and described in U.S. Patent Application Serial No. 09/231,282, which is hereby fully incorporated by reference, the conformal jacket 34 facilitates the positioning of the hearing device 30 within a wearer's ear canal (10). In particular, the conformal jacket 34 forms an acoustic seal between a distal end 36 of the receiver housing 32, which is positioned proximate the wearer's tympanic membrane (16), and the outer ear (17) of the wearer. A sound port (i.e., an opening) 38 is provided in the distal end 36 of the receiver housing 32.

In accordance with one aspect of the invention, a flexible, cylindrical grommet 40 is snuggly seated in the sound port 38. As best seen in Figs. 4 and 5, the grommet 40 is retained by a circular rim 46 of the receiver housing 32, which defines the sound port 38. The grommet 40 comprises a receiver suspension tube 42, which extends into the receiver housing 32. A cylindrical neck portion 52 of a receiver unit 50 is retained by the suspension tube 42, such that sound waves emitted from an audio speaker (not shown) within the receiver unit 50 are directed through the sound port 38. The suspension tube 42 also functions to isolate any vibration of the receiver 50 from the receiver housing 32. In particular, the general flexibility of the grommet 40 provides vibration isolation between the receiver 50 and the receiver housing 32.

In accordance with a further aspect of the invention, a cover piece 44 is "hingedly" attached to the grommet 40, and is sized to substantially cover the sound port 38, thereby functioning as a cerumen guard. In a preferred embodiment, the grommet 40 is preferably made of a flexible elastomeric material, such as rubber or silicon, with the cover piece 44 integrally molded with the rest of the grommet 40 as a single piece construction. One advantage of such material is that the cover piece 44 will be relatively compliant, easing insertion into a sensitive ear canal (10).

As best seen in Figs. 3 and 5, the cover piece 44 is attached by an arcuate extension portion 54 of the grommet 40 proximate the circular rim 46 of the sound port 38. The extension portion 54 is preferably sized such that, taking into account the particular

strength and flexibility of the grommet material, the cover piece 44 can be placed in either a closed (Fig. 4), or open (Fig. 5) position. In particular, as indicated by arrow 56 in Fig. 5, the cover piece 44 pivots about flexible extension portion 54 at the rim 46 of the sound port 38. The compliant material forming the grommet 40 also facilitates the movement of the cover piece 44 about the extension portion 54 of the grommet 40.

In alternate embodiments, the cover piece 44 and grommet 40 may be made of two or more separate pieces, which are bonded together in a way which still allows for the flexible pivoting of the cover piece 44 relative to the circular rim 46 of the sound port 38. Thus, as used herein, the term "hingedly" means that the cover piece 44 may be "pivoted" about the extension portion 54 of the grommet 40 akin to a door being pivoted about its hinges. It is not necessary that there be actual hinges or pins, etc., which attach the cover piece 44 to the grommet 40, although this is also contemplated by the term "hingedly".

In still further embodiments, the cover piece 44 may be completely removable from the grommet 40, e.g., in a "snap-on" configuration.

The cover piece 44 is fashioned with a positioning lip 48, which extends towards the receiver housing 32 from an outer circumferential edge of the cover 44. As seen in Fig. 4, when the cover piece 44 is in a closed position, the positioning lip 48 biases the cover piece 44 slightly away from the sound port 38, providing an annular opening 39 around much of the circular rim 46 of the sound port 38 (i.e., except where the lip 48 and attaching portion 54 are located). The flexible material forming the grommet 40 will allow the cover piece 44 to be easily bent open for cleaning of entrapped cerumen, while being resilient enough to provide a natural biasing to automatically return the cover piece 44 to a closed (i.e., operating) position.

On insertion into a wearer's ear canal (10), the cover piece 44 will tend to collapse shut when pressed against the ear canal wall (11), hence preventing the receiver port 38 from scooping cerumen (14) (i.e., at the rim 46). The resilience of the positioning lip 48 functions to automatically reopen the sound port 38 after insertion.

Although the invention has been described and illustrated in the above description and drawings, it is understood that this description is by example only and that numerous changes and modifications can be made by those skilled in the art without departing from the true spirit and scope of the invention.

The invention, therefore, should not be restricted, except by the following claims and their equivalents.

Claims

1. A hearing device, comprising:

a housing having a sound port; and

a flexible receiver suspension member seated in the sound port, the suspension member including a portion extending into the housing and configured for retaining a receiver unit in a position such that sound waves emitted from the receiver unit are directed through the sound port.

2. The hearing device of claim 1, further comprising a cover configured to block cerumen from accessing the sound port when the cover is in a closed position.

3. The hearing device of claim 2, wherein the cover is integrally molded with the suspension member as a single piece.

4. The hearing device of claim 2, wherein the cover is fashioned with a positioning lip extending from an outer edge of the cover, the positioning lip configured to prevent the cover from sealing the sound port when the cover is in a closed position.

5. A hearing device, comprising:

a receiver housing having a distal end, the distal end having a sound port; and

a flexible receiver suspension member seated in the sound port, the suspension member including a tubular portion extending into the receiver housing, the tubular portion configured for retaining a receiver unit in a position such that sound waves emitted from the receiver unit are directed through the sound port.

6. The hearing device of claim 5, wherein the suspension member further includes a cover configured to block cerumen from accessing the sound port when the cover is in a closed position.

7. The hearing device of claim 6, wherein the cover is integrally molded with the suspension member as a single piece.

8. The hearing device of claim 6, wherein the cover is fashioned with a positioning lip extending from an outer edge of the cover, the positioning lip configured to prevent the cover from sealing the sound port when the cover is in a closed position.

9. An In-The-Canal hearing device, comprising:

a receiver housing having a distal end, the distal end having a sound port; and

a flexible receiver suspension member seated in the sound port, the suspension member including a tubular portion extending into the receiver housing, the tubular portion configured for retaining a receiver unit in a position such that sound waves emitted from the receiver unit are directed through the sound port,

the suspension member further including a cover configured to block cerumen from accessing the sound port when the cover is disposed in a closed position,

wherein the cover is integrally molded with the suspension member as a single piece, and

wherein the cover is fashioned with a positioning lip extending from an outer edge of the cover, the positioning lip configured to prevent the cover from sealing the sound port when the cover is in a closed position.

10. A hearing device, comprising:

a housing having a sound port; and

a flexible member seated in the sound port, the flexible member including a hingedly-attached cover configured to block cerumen from accessing the sound port when the cover is disposed in a closed position.

11. The hearing device of claim 10, wherein the cover is integrally molded with the flexible member as a single piece.

12. The hearing device of claim 10, wherein the cover is fashioned with a positioning lip extending from an outer edge of the cover, the positioning lip configured to prevent the cover from sealing the sound port when the cover is in a closed position.

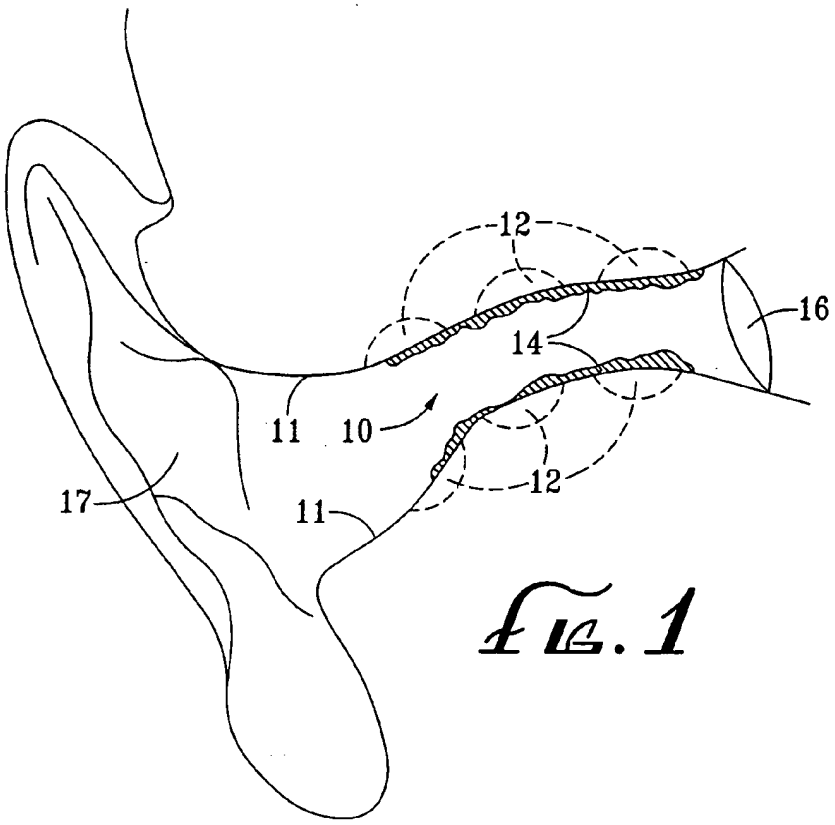


Fig. 1

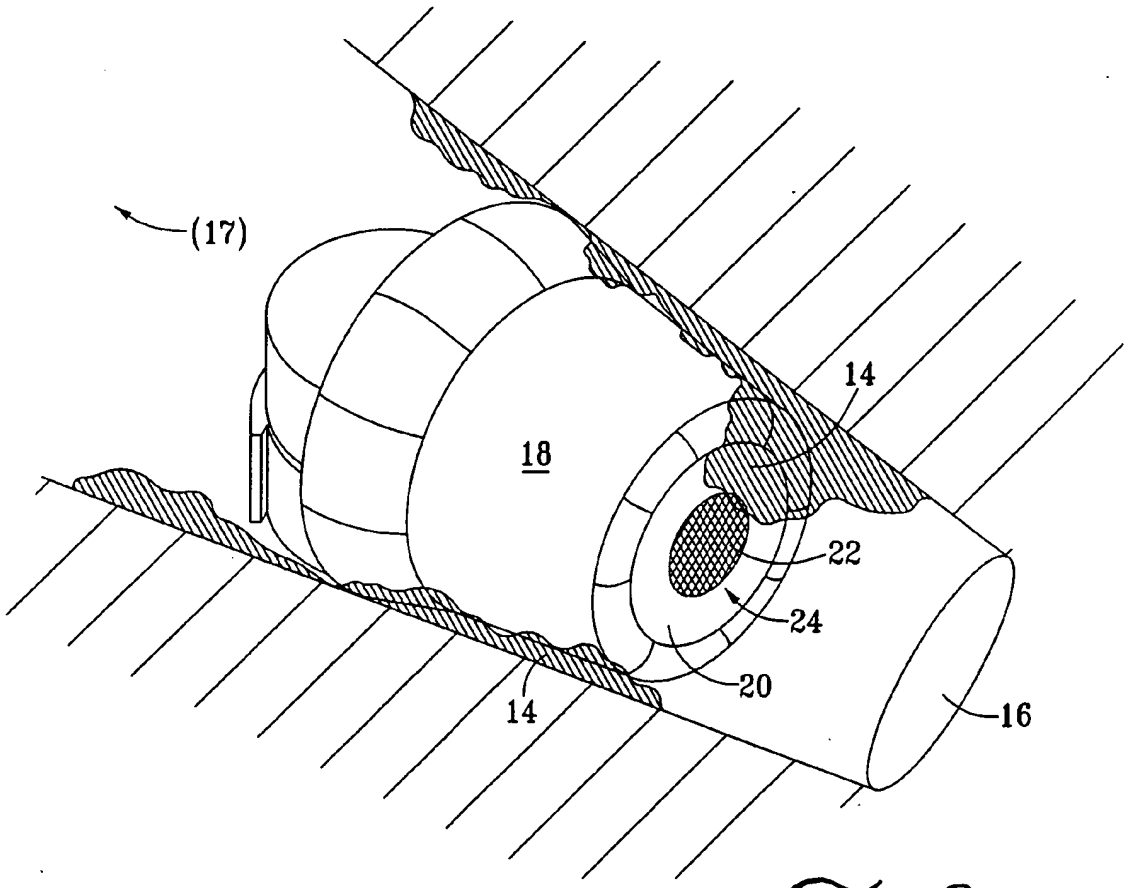


FIG. 2

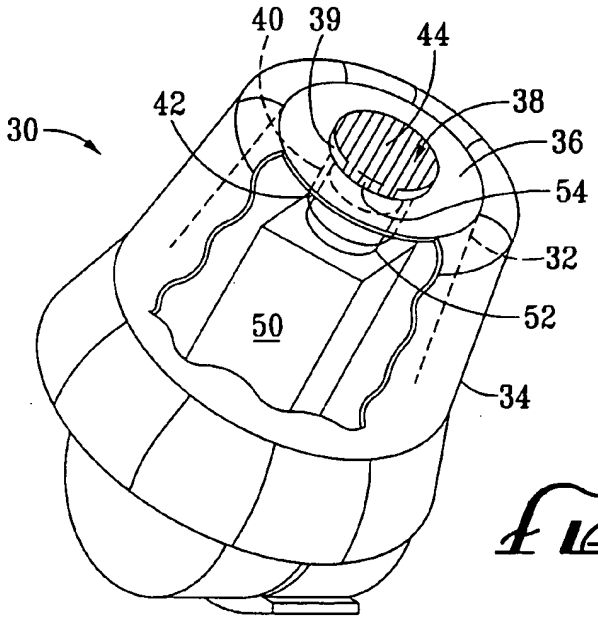


FIG. 3

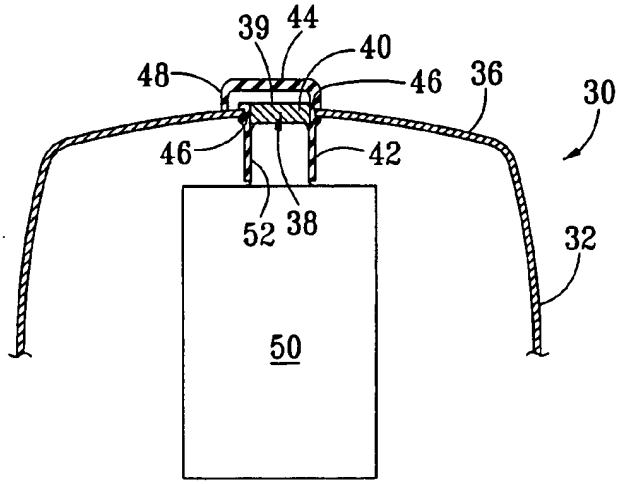

39
44
40
48
46
36
30
46
42
52
38
32
50

FIG. 4

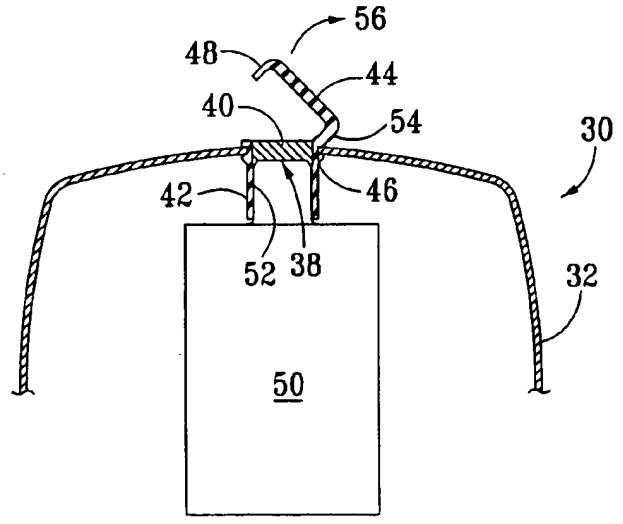

56
48
44
40
54
30
42
46
52
38
32
50

FIG. 5